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Standard Practice

Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

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Foreword

A coating is applied to a substrate to prevent corrosion, reduce abrasion, and reduce product contamination. The degree of coating continuity required is dictated by service conditions. Discontinuities in a coating are frequently very minute and not readily visible. This standard practice provides a procedure for electrical detection of minute discontinuities in new coating systems that are applied to conductive substrates. The user should refer to NACE Standards RP0274,[1] RP0490,[2] and/or TM0384[3] for procedures specific to electrical inspection of pipeline coatings. This standard describes procedures for determining discontinuities using two types of test equipment: low-voltage wet sponge testers and high-voltage spark testers.

This standard is intended for reference in coating specifications or other documents and may be used by specifiers, applicators, and coating inspectors if a specification requires holiday detection on conductive substrates. For the purposes of this standard, the term “coating” can refer either to atmospheric or immersion service.

This standard was originally prepared in 1988 by Task Group T-6A-37, a component of Unit Committee T-6A on Coating and Lining Materials for Immersion Service. It was reaffirmed in 1990, revised in 1999, and reaffirmed in 2006 by Specific Technology Group (STG) 03. This standard is issued by NACE International under the auspices of STG 03 on Protective Coatings and Linings: Immersion and Buried. It combines the input of representatives of coating manufacturers, applicators, inspection agencies, architectural engineers, equipment manufacturers, and general consumers.

In NACE standards, the terms *shall, must, should*, and *may* are used in accordance with the definitions of these terms in the *NACE Publications Style Manual*, 4th ed., Paragraph 7.4.1.9. *Shall* and *must* are used to state mandatory requirements. The term *should* is used to state something considered good and is recommended but is not mandatory. The term *may* is used to state something considered optional.

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Contents

Section 1: General

1.1 This standard provides procedures for low-voltage wet sponge testing and high-voltage spark testing of new coatings on conductive substrates.

1.2 Electrical testing to determine the presence and number of discontinuities in a coating is performed on a nonconductive coating applied to a conductive substrate. The allowable number of discontinuities should be determined prior to conducting this test, because the acceptable number of discontinuities varies depending on coating thickness, design, and service conditions.

1.3 This standard is not intended to provide data on service life, adhesion, or film thickness of an applied coating system. Electrical testing does not detect areas where the coating is thin (even as thin as 25 µm [1.0 mil]).

1.4 This standard is intended for use only with new coatings applied to conductive substrates. Inspecting a coating previously exposed to an immersion condition could result in damage to the coating or could produce an erroneous detection of discontinuities due to permeation or moisture absorption of the coating. Deposits may also be present on the surface, causing telegraphing.

The use of a high-voltage spark tester on previously exposed coatings can result in a spark that damages an otherwise sound coating. A low-voltage wet sponge tester may be used without damaging the coating but can produce erroneous readings.

1.5 To prevent damage to a coating if a high-voltage spark tester is being used, the total film thickness and dielectric strength of the coating system shall be considered in selecting the appropriate voltage for detection of discontinuities.

1.6 The coating manufacturer shall be consulted to obtain the following information, which can affect the accuracy of the tests described in this standard to determine discontinuities:

(a) The length of time required to adequately dry or cure the applied coating prior to testing. Solvents retained in an uncured coating may form an electrically conductive path through the film to the substrate.

(b) Whether the coating contains electrically conductive fillers or pigments that may affect the normal dielectric properties.

Section 2: Definitions

Coating: A liquid, liquefiable, or mastic composition that, after application to a surface, is converted into a solid protective, decorative, or functional adherent film.

Discontinuity: (1) An interruption in the normal physical structure or configuration of a coating such as cracks, laps, seams, inclusions, or porosity. A discontinuity may or may not affect the usefulness of the coating. (2) A condition in which the electrical path of a structure is interrupted by a device that acts as a dielectric or insulated fitting. May also be identified as a holiday or pinhole.

Holiday: A discontinuity in a protective coating that exposes unprotected surface to the environment; in this standard, a term used interchangeably with discontinuity.

Holiday Detector: A device that locates discontinuities in a coating applied to a conductive substrate.

Pinhole: A minute hole through a coat or coats that exposes an underlying coat or the substrate.

Telegraphing: Current that travels through a moisture patch to a discontinuity, causing an erroneous discontinuity test result.

Section 3: Low-Voltage Wet Sponge Testing

3.1 Equipment

3.1.1 A low-voltage wet sponge tester is an electronic device powered by a self-contained battery with voltages ranging from 5 to 90 V direct current (DC), depending on the manufacturer's circuit design. It is used to locate discontinuities in a nonconductive coating applied to a conductive substrate. Operation includes the use of an open-cell sponge electrode saturated with a solution for exploring the coating surface, a ground connection, and an audible or visual indicator for signaling a point of coating discontinuity.

3.1.2 The operating voltage of a low-voltage wet sponge tester is a function of the particular electronic